WE CLAIM:

1. A network element (NE) of a data transport network across which a tunnel is provisioned, the NE comprising:

   a signal processor for maintaining a local occupancy status of a tunnel segment of the tunnel adjacent the NE, the signal processor adapted to use the local occupancy status and content of protection switch messages received from adjacent NEs of the tunnel to control use of data transport capacity over a link that locally supports the tunnel segment, and communicates the use of the data transport capacity to adjacent NEs of the tunnel, in protection switch messages; and

   a messaging system for exchanging the protection switch messages with adjacent NEs of the tunnel enabling distributed processing of the protection switch messages across the tunnel.

2. The NE as claimed in claim 1 wherein the tunnel is a bidirectional tunnel, and the messaging system is a full-duplex messaging system that transmits the protection switch messages on two bidirectional links, if the NE is a tandem of the tunnel, and on one bidirectional link if the NE is an end point of the tunnel.

3. The NE as claimed in claim 2 wherein the signal processor is further adapted to monitor each bidirectional link, and to relay a tunnel condition protection switch message in an opposite direction of

a detected link condition, if a link condition is detected at the NE, and the NE is a tandem.

4. The NE as claimed in claim 3 wherein the messaging system comprises, for each of the bidirectional links, paired frame reception hardware and frame transmission hardware for processing consecutive frames of data transported over the bidirectional link, and the messaging system is provided by an automatic protection switch (APS) overhead of the frames that is presented to the signal processor with expedited interrupt-based handling.

5. The NE as claimed in claim 4 wherein the signal processor is adapted to control the use of the data transport capacity by inserting pended and preempted indicators in the APS messages, which originate at end points of the tunnel.

6. The NE as claimed in claim 5 wherein the signal processor is adapted to pend a received switch request if a current occupancy of one of the tunnel segments over which the switch request is transmitted is of an equal or higher priority than a request priority contained in the switch request.

7. The NE as claimed in claim 5 wherein if the tunnel passing through the NE is transporting live traffic, and a request of a higher priority is received from another tunnel for the data transport capacity of one of the tunnel segments of the tunnel, the NE initiates a preemption of the tunnel by inserting the preempted indicator into the APS messages in both directions.

8. A method for processing automatic protection switch (APS) messages at a network element (NE) in a tunnel provisioned across a data transport network, the method comprising:

determining whether the NE is an end point of the tunnel, or a tandem of the tunnel, when a new APS message is received at the NE;

if the NE is a tandem, applying a message handling procedure for the new APS message using local information about tunnel segments of the tunnel only maintained by the NE, to update the local information, and to selectively forward the updated information to adjacent NEs of the tunnel; and

if the NE is an end point, updating a status of the tunnel.

9. The method as claimed in claim 8 further comprising:

receiving a notice of a link condition on a link of the NE supporting one of the tunnel segments, and, if the NE is a tandem of the tunnel, originating a tunnel condition message used to indicate the link condition to the tunnel end point, so that a protection switch may be initiated;

receiving a tunnel status message from an adjacent NE in the tunnel from a K-byte overhead of a frame that serves as a data transport unit of the network; and

receiving a message from a network management that prompts a protection switch, if the NE is an end point of the tunnel.

10. The method as claimed in claim 9 wherein if the link condition is a signal degrade on a working tunnel, the originating the tunnel condition further comprises:

forwarding a tunnel condition message in the K-byte overhead to both adjacent NEs in the tunnel;

waiting for a reply to the tunnel condition messages from the end points of the tunnel via the adjacent NEs; and

receiving without forwarding the tunnel condition replies until the signal degrade link condition ends.

11. The method as claimed in claim 9 wherein receiving a tunnel status message from an adjacent NE comprises receiving one of the following:

a protection switch request used to erect a protection tunnel; and

a cede message, or a preempt message used to release a protection tunnel.

12. The method as claimed in claim 11 wherein applying the message handling procedure upon receipt of a protection switch request message, comprises:

identifying an occupant priority of data transport capacity supporting the tunnel segments of the tunnel;

comparing the occupant priority with a priority contained in the protection switch request to determine whether the protection switch is locally allowable;

forwarding the protection switch request over the tunnel segment if the protection switch is locally allowable; and

forwarding a pended protection switch request over the tunnel segment if the protection switch is locally not allowable

13. The method as claimed in claim 12 wherein comparing the occupant priority with the protection switch request priority comprises:

deeming the protection switch request allowed if the data transport capacity is unoccupied, and the occupant priority is consequently null;

deeming the protection switch request allowable if the occupant priority is less than the protection switch request priority; and

deeming the protection switch request not allowable if the occupant priority is greater than or equal to the protection switch request priority.

14. The method as claimed in claim 13 wherein the tunnel is a bidirectional tunnel, and the receiving the protection switch request comprises receiving the protection switch request from an adjacent NE in a first direction of the tunnel, removing any occupant, and building the cross-connect if the protection switch request is allowable, and an unpended switch request is received from the tunnel, in a direction opposite the first direction.

15. The method as claimed in claim 14 further comprising building the cross-connect as soon as the switch

request is deemed allowed, and if the switch request received from the opposite direction is pended, taking down the cross-connect.

16. A method for processing a protection switch request at a network element (NE) in a tunnel provisioned across a data transport network, the method comprising:

receiving the protection switch request, and determining whether the NE is an end point of the tunnel, or a tandem of the tunnel; and

if the NE is a tandem, using an occupancy status of a tunnel segment of the tunnel only maintained by the NE, and a priority of the protection switch request to determine whether the protection switch is locally allowable; forwarding the protection switch request over the tunnel segment if the protection switch is locally allowable; and forwarding a pended protection switch request over the tunnel segment if the protection switch is locally not allowable.

17. The method as claimed in claim 16 further comprising maintaining the occupancy status by storing information related to whether data transport capacity that supports tunnel segments of the tunnel is idle, or a tunnel segment of an occupant tunnel is switch connected to another tunnel segment, and uses the data transport capacity; an occupant priority of the occupant tunnel; a link condition of a link providing the data transport capacity; and whether the NE is preempting the occupant tunnel, or pending the protection switch request.

18. The method as claimed in claim 17 wherein the determining whether the protection switch request is locally allowable comprises:

comparing the priority contained in the protection switch request with the occupant priority;

deeming the protection switch request allowed if the data transport capacity is unoccupied;

deeming the protection switch request allowable if the occupant priority is less than the protection switch request priority; and

deeming the protection switch request not allowable if the occupant priority is greater than or equal to the protection switch request priority.

19. The method as claimed in claim 18 wherein the tunnel is a bidirectional tunnel, and the receiving the protection switch request message comprises receiving the protection switch request from an adjacent NE in a first direction of the tunnel, preempting the current occupant, and building the cross-connect if the protection switch request is allowable, and an unpended switch request is received from the tunnel, in a direction opposite the first direction.

20. The method as claimed in claim 19 further comprising building the cross-connect as soon as the switch request is deemed allowed, and if the switch request received from the opposite direction is pended, taking down the cross-connect.